***Science Curriculum Review Executive Summary***

**Science Mission/Vision**



The Franklin Public Schools science program will provide all students with a relevant inquiry-based culture that creates a community of explorers where curiosity, creativity, and questioning are valued, where resources and opportunities are made readily available and where students can “work” like scientists engaged in the process of collective sense-making.

**Science Curriculum Review**

The Franklin School District Science Committee conducted an audit on the state of science curriculum in the district. The audit consisted of four parts:

* Science Best Practices and Research
* Data Day results
* Science Foundation (draft) standards
* GAP Analysis of current program and curriculum

Listed below are the major findings and recommendations for each area of the science audit. It is noteworthy that many of these recommendations were duplicated in various parts of the audit. Recommendations were combined and listed in only one section to avoid duplication.

***PART 1: BEST PRACTICES AND RESEARCH IN SCIENCE***

**Introduction:**

Science articles and two books were read and summarized into the following areas: Vision/Instructional Focus; Effective Programs Resources, Potential Direction for EKS/Power Standards; Curriculum Design.

**Article/Book Titles:**

*Ready, Set, SCIENCE!*

*What Does Research Say About Science?*

*Inquiry Within*

*Science Inquiry*

*Best Practice in Science*

*What Science Teaching Looks Like*

*Differentiated Curriculum Enhancement in Inclusive Middle School Science*

***PART 1: BEST PRACTICES AND RESEARCH IN SCIENCE (continued)***

**Major Findings:**

1. Vision / Instructional Focus:

* Inquiry Based Science, use science as a tool
* Combine Process with Content, to act like a Scientist, to produce students that are science literate
* Need for reform and ramp rigor, but relate to life experience
* Special Education recommendation: differentiated instruction w/peer partners; inclusive science setting

1. Effective Program Resources:

* Project 2061
* Atlas of Science Literacy
* McRel NRC document
* Inquire Within, including resource in back of book

1. Potential Direction for EKS / Power Standards:

* Students must be able to think scientifically
* Emphasis on process skills
* Link content to process
* Students must understand relationship and make connections
* Less is more…

1. Curriculum Design:

* Less is more…
* Inquiry based across learning and assessment
* Interconnectiveness between science, school and community (spiraling and interdisciplinary)
* Allow time for self assessment, reflection, sharing
* Transitions between major themes/ideas
* Authentic
* Relating to 21st Century Skills

1. Other Good Ideas... and Needs:

* Use multiple science procedure, no one way to teach science
* Using evidence to change students misconceptions

***PART 1: BEST PRACTICES AND RESEARCH IN SCIENCE (continued)***

1. What "trends or directions" of science education were indicated?

* Less is more. (Depth not breadth, quality of understanding not quantity of information)
* Connecting math, science, and technology, literacy (STEM)
* Inquiry, student centered exploration of the process of science
* Collaborating across the grade levels

1. What science sequence/processes would be applicable in our design for the

K - 12 scope and sequence?

* Spiraling
* Modeling

**Recommendations:**

1. Vision / Instructional Focus
   * + The solution demands that the science classroom be transformed into a relevant inquiry-based culture… a community of explorers… where curiosity, creativity, and questioning are valued, where resources and opportunities are made readily available, and where students can “work” like scientists engaged in the process of collective sense making.
     + Consider student learning styles through differentiation
     + Define Inquiry
2. Effective Program Resources
   * + Need for research based / best practice materials, or tools for each room
     + Sufficient space and time
     + Develop a plan for continuous professional growth in science knowledge, the teaching of science, and how to assess science to include continual collaboration across grade levels
3. Potential Direction for EKS / Power Standards
   * + Develop power standards around the four strands of science education: Understanding Scientific Explanations; Generating Scientific Evidence; Reflecting on Scientific Knowledge; Participating Productively in Science – use Science Foundations document as our guide

***PART 1: BEST PRACTICES AND RESEARCH IN SCIENCE (continued)***

1. Curriculum Design
   * + Inquiry based authentic curriculum related to 21st Century Skills that spirals throughout K – 12 scope and sequence
     + Determine frequency of science instruction
     + Determine where curriculum integration is possible, i.e. science integrated with other disciplines
     + Program evaluation: How will we know we are achieving what we plan?
2. Other good ideas
   * + Does Franklin want a “trademark” i.e. community connections, creative direction
3. What trends or directions of science education were indicated?
   * + Connecting math, science, technology, literacy (STEM)
4. What science sequence / processes would be applicable in our design for the K – 12 scope and sequence?
   * + Recommendations incorporated above

***PART 2: DATA REVIEW***

**Introduction:**

A subgroup of the Franklin Public Schools District Science Committee convened in early December 2008 to examine a variety of data sources related to science education and student achievement in science. The group reviewed documents from national and state testing (NAEP, WKCE, ACT, PLAN), district demographics, and high school science course offerings. Several trends were noted. Franklin’s WKCE scores trend downward from higher scores at the elementary level to lower schools at the middle and high school level. However, scatter plots and district comparisons reveal that there are many districts where this downward trend does not occur, revealing that it is possible to have high achievement measures at all levels.

The WKCE item analysis revealed that the areas of *Science Inquiry,* and *Earth/Space* had the greatest number of incorrect answers at all three tested grades (4, 8, 10). Skill and process areas that were noted as lower were: Interpreting/Reading Charts at the 4th grade level; Making Inferences/Drawing Conclusions and Basic Science Terms at the 8th grade level; and sequencing at the 10th grade level. In general, WKCE scores were above state averages at 4th and 8th grade with some 10th grade scores below the state average. See full report for these details.

On the ACT, Franklin students have science scores that are higher than the state and national averages, but are below the College Readiness mark. On the PLAN (10th grade), Franklin students’ science scores are higher than the other three tested subject areas (English, reading, math), but this is not true on the ACT.

***PART 2: DATA REVIEW (continued)***

To address the areas of concern that are identified in the interpretation of the data, several recommendations should be considered. The District Science Committee needs to consider what might be done differently at the elementary and middle school levels (teaching strategies, methods, or approach) to prepare students more effectively for high school. Also, consistency is needed in elementary science programming across all schools, and any revised curriculum needs to be supported by professional development for effective implementation. Board of Education Policies need to be revised to reflect requirements. The sequence of courses and content that are offered K - 12 needs to be reviewed and aligned with standards. Schools and districts with successful science programs should be contacted for comparisons and ideas about content, sequencing, and other program considerations. The question of whether to require a third year of high school science needs to be addressed. The question of test preparation in science content needs to be addressed. Finally, it is critical that the science program addresses high levels of thinking at all grade levels.

**Major Findings:**

***WKCE & NAEP:***

Franklin’s WKCE scores trend downward as the grade levels increase. (This trend is not found in all districts.)

Students scoring proficient or advanced on WKCE at each grade level:

* 4th Grade: 92.5%
* 8th Grade: 88%
* 10th Grade: 80%

Wisconsin students score 37% proficient/advanced on the NAEP test, compared to 80%+ proficient/advanced on WKCE.

***WKCE Item Analysis:***

The standards of Science Inquiry and Earth/Space Science had the greatest number of incorrect answers at all three tested grades.

Skill and process areas scoring lower were:

* 4th Grade: Making inferences/Drawing conclusions
* 8th Grade: Basic science terms
* 10th Grade: Sequencing

The scores indicate that science literacy is lacking.

All levels scored lower in Science Inquiry and Earth/Space

***PLAN/ACT:***

Franklin students’ ACT science scores are higher than the state and national averages, but are below the College Readiness mark identified by ACT.

***PART 2: DATA REVIEW (continued)***

***Elementary Science Survey Results:***

Low Individual Areas indicate the following needs:

* Teachers need opportunities to remain current in science.
* Every child should experience science every day. (Esp. since NCLB)
* Horizontal and vertical alignment is needed.

**Recommendations:**

1. A K - 12 scope and sequence needs to be implemented at all schools in the district. (Note: consistency is needed across all elementary schools.)
2. Students need to practice higher order thinking and questioning through **true inquiry** (not just “hands on”).
3. Revised curriculum needs to be supported by professional development to ensure effective implementation.
4. Teachers need to be taught what true inquiry is and how to implement and assess it.
5. We need a science point person to act as a resource to teachers who don’t have a science background.
6. To make inquiry possible, we need to make more time for science and decrease breadth of content while increasing depth.
7. We need to visit schools/districts where scores don’t trend downward to examine staffing, personnel responsibilities, curriculum, and best practices in classroom.
8. Science literacy should be reflected across the curriculum. (We should find trade books, other resources, etc. that support the science curriculum.)

***PART 3: SCIENCE FOUNDATIONS STANDARDS***

**Introduction:**

The Draft of the Wisconsin Science Foundations was reviewed by members of the Science Curriculum Committee. This document provided significant insight into how a comprehensive, spiraled, standards based curriculum might be developed. Although we have learned that this document will never be published, the information that it contains is immensely valuable. It provides both a number of resources for those developing curricula as well as a sample set of comprehensive grade level expectations. This document, coupled with the comments of Dr. Shelley Lee, provide significant guidance to school systems wishing to provide a top rate science education for their students.

***PART 3: SCIENCE FOUNDATIONS STANDARDS (continued)***

**Major Findings:**

Throughout the Grade Level Foundations document there is a common ongoing emphasis on the broad, far-reaching areas within science, specifically the nature of science, science practices and the skills to do science. There is a similar emphasis on the need to integrate the instruction of science across the learning of both a grade level (horizontally) and through the grades (vertically).

The Foundations and Wisconsin Science Curriculum consultant, Dr. Shelley Lee, both emphasize the importance of incorporating the preparation of students in the 21st Century as described by the 21st Century Skills Initiative within science. They both make the statement that in fact “Science is the practice of the 21st Century Skills”. Within the classroom this would include a balance of academic science content with the real world skill of doing science.

There is a specific need among the instructors of science to engage in ongoing professional development regarding the design of effective science lessons, the use of curriculum, and the dramatic changes in science education.

**Recommendations:**

1. Development of a set of Essential Knowledge and Skills standards with the Foundations as a primary source of those global skills.
   * These should be developed at each grade level as well as across the district.
   * A set of learning objectives for each unit of instruction should be developed that reflect the expected outcomes of the EKS’s
2. 21st Century Skills should be integrated across the curriculum and specifically within science. LIST SKILLS
3. Professional Development
   * Within the content area and developing fields of science there is a need to access the expertise of those that are actually using and developing science.
   * In terms of developing capacity within the district, the development of science curriculum can be done with broader resources. The resources recommended specifically are McREL Effective Science Lessons, and DPI’s Planning Curriculum in Science.

***PART 4: GAP ANALYSIS of CURRENT PROGRAM AND CURRICULUM***

This document has been developed as part of the K - 12 Science Curriculum Cycle review which began in September 2008. This GAP Analysis was developed in part by using the Wisconsin State Science Foundations draft document, which supplied the latest set of grade-by-grade science standards in the identified areas of Nature of Science, Science Practices/Inquiry, Science Skills, and Science Knowledge/Concepts. This GAP Analysis utilizes those standards to compare the scope of coverage that exists with the current curriculum resources at all grade levels K - 9.

It should be noted that although the best effort was taken to identify how well our current curriculum units matched the stated grade level standards noted, it is not meant as a measurement to what degree these standards are currently being introduced, taught, or assessed in each classroom, but serves to identify if those standards could be met or may not be met by using our current curriculum resources.

It should be noted that there very well may be current curriculum resources that could satisfy particular standards found at a different grade level, but these would have to be identified as a possible unit of study that could be moved and used at a different grade level.

**Major Findings:**

Based on the results of this GAP Analysis, our current science program does offer a degree of compatibility with the Wisconsin Science Standards; however, a number of “gaps” are evident and better agreement should be possible in our new science program.

The current elementary science program seems to be somewhat fragmented in coverage. Three different curriculum resources are currently being used across all K - 6 grades. Although this instrument did not measure the validity or level of participation for each identified unit, past practice has shown a wide disparity in the degree in which these units are taught. It was noted that 1) the current elementary science program covers areas of Science Practice/Inquiry generally well but needs strengthening in the upper levels of science discovery/inquiry, especially in the areas of Nature of Science. 2) Overall, there exists a number of “gaps” in the draft standards being considered, and if adopted, could possibly be corrected with better selection of matching curriculum resources. 3) As you progress up through the grades, it was noted that there is a “falling off” of the Science Knowledge/Concepts coverage due to both a higher level of science processing standards and program units that just do not fit the standards and guidelines being considered.

The current middle school science program and curriculum resource modules may need closer scrutiny as the proposed standards dramatically increased in science topics and required objectives. While the current program is designed as a modular approach, it seems that a better mix of modules may need to be considered, possibly adding supplementary materials to better align standard needs. A different selection of curriculum resources may be needed.

***PART 4: GAP ANALYSIS of CURRENT PROGRAM AND CURRICULUM (continued)***

The current high school science program, which has only two 9th grade offerings of Physical Science and Biology, may need to be revised to raise the level of rigor. Currently, we fall short in the areas of Science Inquiry, Skills and Science Process, pushing more of the Knowledge/Concepts. Earth Science is completely absent at this level.

**Recommendations:**

Points to consider…

* Look at shifting units from one grade to another based on the science standards model.
* Possible integrated science standards in a module form.
* Investigating the assessment aspect of science.
* Making sure is a balance of the three science concepts (Life, Physical, and Earth) at each grade level. The fourth unit should balance the science concepts across the grade levels (not always the same area in each grade).
* Investigate a new program at the elementary level instead of using three different programs (Einstein, Franklin Units, McMillan). This new program should better support the flow of the science standards.
* Consider expanding the current middle school science program to both sixth grade and ninth grade.
* Ensure higher levels of thinking skills appropriate to the developmental level of students.
* Create a tracking system of supplies, equipment, technology, and teacher training.
* Consider creating a district wide science budget that allows updating current facilitates to support inquiry-based science instruction.
* Vertical and horizontal alignment within the curriculum is necessary.
* Evaluate missing content and skills in gap areas
* Ensure a coordinated, spiraling curriculum
* Consider Bloom’s Taxonomy of Cognitive Skills as a guide to construct the curriculum
* Develop assessments that require rigor and contribute to student learning
* Ensure access to equipment, technology and learning materials to implement the revised curriculum
* Ensure continuous, high-quality professional development for the effective implementation of the curriculum

***PART 4: GAP ANALYSIS of CURRENT PROGRAM AND CURRICULUM (continued)***

**Combined Recommendations for the four parts that were audited**:

* + 1. The solution demands that the science classroom be transformed into a relevant, truly inquiry-based culture that promotes higher order thinking… a community of explorers… where curiosity, creativity, and questioning are valued, where resources and opportunities are made readily available, and where students can “work” like scientists engaged in the process of collective sense making.
    2. Consider student learning styles through differentiation
    3. Define Inquiry (NSTA)
    4. Develop a plan for continuous professional growth in science knowledge, the teaching of science, and how to assess science to include continual collaboration between and across grade levels to ensure effective implementation.
* Special attention should be given to professional development at the grade level as related to their content.
* To ensure that science content knowledge is current, outside expertise and resources should be consulted.
  + 1. A K - 12 scope and sequence needs to be implemented at all schools in the district. (Note: consistency is needed across all elementary schools.)
    2. Develop power standards based on the *Foundations* document, DPI documents, the four strands of science education as cited in *Ready, Set, Science* and its high school counterpart. (Understanding Scientific Explanations; Generating Scientific Evidence; Reflecting on Scientific Knowledge; Participating Productively in Science)
* Decrease breadth of content while increasing depth.
* The resources recommended specifically are McREL Effective Science Lessons, and DPI’s Planning Curriculum in Science.
  + 1. From these power standards essential knowledge and skills will be developed as appropriate for each grade level or course.
    2. Units of study will be developed to include learning objectives. These will reflect the Essential Knowledge and Skills.
* Making sure is a balance of the three science concepts (Life, Physical, and Earth) at each grade level. The fourth unit should balance the science concepts across the grade levels (not always the same area in each grade).
  + 1. Develop inquiry based authentic curriculum related to 21st Century Skills that spirals throughout the K – 12 scope and sequence.
    2. Determine frequency and extent of science instruction.
    3. Using the district-wide school improvement process, the Science Program should be evaluated on an annual basis.

***PART 4: GAP ANALYSIS of CURRENT PROGRAM AND CURRICULUM (continued)***

* + 1. Franklin Public Schools should consider developing a “trade mark” emphasis within the Science program i.e. community connections, creative direction, subject area expertise.
    2. Methods for implementing and assessing all aspects of the Science curriculum need to be developed including true inquiry.
    3. Science coordinator should provide content based professional development at all levels.
    4. We need to visit schools/districts where scores don’t trend downward to examine staffing, personnel responsibilities, curriculum, and best practices in classroom.
    5. Determine where curriculum integration is possible, i.e. Science integrated with other disciplines.
* Science literacy should be reflected across all the curricular areas. (We should find trade books, other resources, etc. that support the science curriculum.)
* Connecting math, science, technology, literacy (STEM)
  + 1. Look at shifting units from one grade to another based on the science standards model.
    2. Investigate a new program at the elementary level instead of using three different programs (Einstein, Franklin Units, McMillan). This new program should better support the flow of the science standards.
    3. Consider expanding the current middle school science program to both sixth grade and ninth grade.
    4. Create a standard base line of supplies and equipment for each classroom, grade level or course based on best practices and research.
    5. Create a tracking system for the purpose of monitoring and replacing/updating supplies, equipment, technology, and teacher training.
    6. Consider creating a district wide science budget that allows updating current facilitates to support inquiry-based science instruction and technology.

***PART 5: CURRICULUM DEVELOPMENT / REVISION***

Following the conclusion of the self-study and review, the committee collaborated to create a document to reflect a *common core curriculum* that meets and/or exceeds state and national standards. Before it becomes the official guide for teachers, the completed draft curriculum document will be reviewed by teachers who are responsible for it’s implementation as well as the Instructional Services Department Resources to support the implementation will be recommended by the District Curriculum Committee created to oversee the review, development and implementation of the curriculum

***See Appendix A for K -5, 6-8 and 9-12 programming details****.*

***PART 6: REVIEW AND SELECT RESOURCES***

Resources (such as textbooks, hardware, software, consumable and non-consumable resources and equipment) selected for the review based on their alignment with the common core curriculum. The committee devoted approximately 20 hours to listening to vendor presentations; narrowing down the selection and determining what resources would support the implementation of the revised curriculum.

The following vendors presented their resources:

**K – 8**

* The Einstein Project
* Carolina Biological Supply
* Houghton Mifflin – Harcourt
* Hold McDougal
* Pearson Scott Foresman
* Science Companion
* Delta/Foss Education
* Project Based Inquiry Science: It’s About Time

Using the information gathered on the textbook selection criteria form, the K – 5 committee members selected to pilot Delta/Foss and Science Companion because of their heavy emphasis on inquiry.

**Final Selection:**

K – 5 committee members selected Foss (Full Option Science System)

6 – 8 committee members selected PBIS: It’s About Time (Project Based Inquiry Science)

9 – 12

|  |  |
| --- | --- |
| **Class** | **Textbook** |
| Chemistry (T 1) | (Glencoe) Chemistry Concepts and Applications |
| Advanced Chemistry | (Holt) Modern Chemistry Davis, Frey, et al |
| AP Chemistry | Chemistry, 8th Edition, AP edition, Zumdahl & Zumdahl |
| Physics (T 1) | Conceptual Physics (Current one used; new not needed) |
| Advanced Physics | College Physics- A strategic Approach, Knight/Jones/Field |
| AP Physics | College Physics Serway |
| Biology (T 1) | Biology (foundation edition) Miller & Levine |
| Advanced Biology | (haven’t decided yet; between Miller and Levine (regular edition, not “foundation” as for tier1 OR Glencoe Biology |
| AP Biology | **Biology 8th Ed., Campbell/Reece, Pearson Benjamin-Cummings, 2008 (new version of current text)** |
| Human Anat. & Physiology | Current text (new not needed) Fundamentals of Anatomy & Physiology, Martini & Nath |
| Medical Terminology | (Text determined by MATC agreement) Exploring Medical Language |
| Environmental Science | (Holt) Environmental Science, Arms |
| Forensic Science | Not decided yet:  **1st Choice:  Forensic Science-Fundamentals & Investigations, Anthony J. Bertino, South-Western Cengage Learning 2008**  2nd Choice:  Forensic Science for High School 2nd Ed, Barbara Ball-Deslich, Kendall Hunt Publishing, 2009 |
| Astronomy | Astronomy: Journey to the Cosmic Frontier (McGraw Hill pub) |
| Geology | Physical Geology (McGraw Hill pub) |

Environmental, Astronomy, and Geology had limited texts from which to choose.

All others provided at least 6 texts to choose from.

***PART 7: IMPLEMENTATION***

Implementation of the adopted curriculum will occur over a four-year window. During the implementation phase, staff will work to maintain consistency in the delivery of the adopted curriculum. Modifications to the adopted curriculum will occur only after they have been discussed and agreed upon by the affected grade level/course staff in collaboration with the Curriculum Coordinator. The agreed upon modifications will be forwarded to the Director of Instructional Services to determine their appropriateness in view of the total district program. Final approval for modifications will be forwarded from the office of Instructional Services to all affected teaching staff.

**Appendix A**

**Science K-8 Units Chart – Scope and Sequence**

**January 2010**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Qtr 1** | **Qtr 2** | **Qtr 3** | **Qtr 4** |
| **Gr. K** | Wood & Paper | | Animals 2 x 2 | |
| Teacher-made activities to address Earth Science EKS’s | | | |
| **EKS Area** | Properties Sorting, Parts, Take apart | | Living Things | |
| **Gr. 1** | Air & Weather | Solids & Liquids | | New Plants |
| **EKS Area** | Weather | Matter: Solids, Liquids, Gases | | Plants |
| **Gr. 2** | Pebbles, Sand & Silt | Balance & Motion | | Insects & Plants |
| **EKS Area** | Rocks, Soil | Motion, Speed, Force | | Animals Life Cycles |
| **Gr. 3** | Sun, Moon & Stars | Physics of Sound | Matter &Energy | Structures of Life |
| **EKS Area** | Sun, Moon, Stars | Sound | Light & Energy | Plants: Living & Non Living Things |
| **Gr. 4** | Water | Magnetism & Electricity | Earth Materials | Human Body |
| **EKS Area** | Water: Uses, States, Movement | Electricity, Magnets, Circuits | Earth, Land, Water | Structure, Muscles, Bones |
| **Gr. 5** | Solar Energy | Mixtures & Solutions | Models & Designs | Environments |
| **EKS Area** | Seasons: Earths rotation; Effects of uneven solar energy | Matter: Physical, Chemical, some only visible with magnification. Heat is a byproduct when changing forms | | Organisms & Environments |
| ***K – 5 Unit Delivery: Average of 25 lessons/days per unit*** | | | | |
| **Gr. 6**  **PBIS Units** | Digging In (Launcher Unit)  28 |  | Energy  74 | Ever-Changing Earth  43 |
| **EKS Area** | Energy (Heat, Light, Sound, etc.) | Earth Science Internal & Surface Structure |
| **Gr. 7**  **PBIS Units** | Diving Into Science (Launcher Unit)  27 | Good Friends & Germs  47 | Astronomy  53 | Vehicles In Motion  28 |
| **EKS Area** | Human Body Systems | Astronomy | Motion |
| **Gr. 8**  **PBIS Units** |  | Genetics  53 | Planetary Forecaster  45 | Air Quality  66 |
| **EKS Area** |  | Cells & Heredity | Weather/Climate | Chemistry |

**K - 5 Science Program Overview**

**Unit Descriptions by Grade Level**

**Kindergarten**

Unit Title: *Wood & Paper*

In the *Wood and Paper* Unit students are introduced to a wide variety of woods and papers in a systematic way. They will observe the properties of these materials and discover what happens when they are subjected to a number of tests and interactions with other materials. Students learn that wood and paper can be recycled to create new forms of paper or wood that have new properties. Finally, they use what they know about the properties of these marvelous materials as they change wood and paper into a variety of products. Throughout the module, students have ample opportunities to compare different kinds of wood, different types of paper, and wood and paper. The concept of trees as natural resources is introduced.

Unit Title: *Animals Two By Two*

The *Animals Two by Two* Unit provides young students with close and personal interaction with some common land and water animals. Appropriate classroom habitats are established, and students learn to care for the animals. In four activities the animals are studied in pairs. Students observe and care for one animal over time, and then they are introduced to another animal similar to the first but with differences in structure and behavior. This process enhances opportunities for observation, communication, and comparison.

**Grade 1**

Unit Title: *Air & Weather*

The *Air and Weather* Unit consists of four sequential investigations, each designed to introduce concepts in earth science. The investigations provide opportunities for young students to explore the natural world by using simple tools to observe and monitor change.

Unit Title: *Solids & Liquids*

The *Solids and Liquids* Unit provides experiences that heighten students' awareness of the physical world. Matter with which we interact exists in three fundamental states: solid, liquid, and gas. In this module first and second graders have introductory experiences with two of these states of matter, solid and liquid.

Unit Title: *New Plants*

The *New Plants* Unit provides experiences that heighten students' awareness of the diversity of life in the plant kingdom. Students care for plants to learn what they need to grow and develop. They observe the structures of flowering plants and discover ways to propagate new plants from mature plants (from seeds, bulbs, roots, and stem cuttings). They observe and describe changes that occur as plants grow, and organize their observations on a calendar and in a journal.

**Grade 2**

Unit Title: *Pebbles, Sand, & Silt*

The *Pebbles, Sand, and Silt* Unit consists of four sequential investigations, each designed to introduce concepts in earth science. The investigations provide experiences that heighten students' awareness of rocks as earth materials and natural resources. They will come to know rocks by many names and in a variety of sizes. Pebbles and sand are the same material—just different sizes.

Unit Title: *Balance & Motion*

In the *Balance and Motion* Unit students learn about the dynamic world where everything is in motion, or so it seems. They also learn that not everything is moving the same way. Some things move from one place to another. Other things go around and around in a rotational motion. Still other things are stationary, stable for a time, balanced on a thin line between stop and go. These are the global phenomena make up students’ experience in this unit.

Unit Title: *Insects*

The *Insects* Unit provides experiences that heighten students' awareness of the diversity of animal forms. They come to know firsthand the life sequences of a number of insects. In each investigation an insect is introduced, and students observe structures and behaviors, discuss their findings, and ask questions. Students observe life cycles of insects and compare the stages of metamorphosis exhibited by each species.

**Grade 3**

Unit Title: *Sun, Moon, & Stars*

The *Sun, Moon and Stars* Unit consists of three sequential investigations, each designed to introduce students to objects we see in the sky. Through outdoor observations made during the day and at night, active simulations, readings, videos, and discussions, students study the Sun, Moon, and stars to learn that these objects move in regular and predictable patterns that can be observed, recorded, and analyzed.

Unit Title: *The Physics of Sound*

The *Physics of Sound* Unit consists of four sequential investigations, each designed to expose a specific set of concepts. Students learn to discriminate between sounds generated by dropped objects, how sounds can be made louder or softer and higher or lower, how sounds travel through a variety of materials, and how sounds get from a source to a receiver. The investigations provide opportunities for students to explore the natural and human made worlds by observing and manipulating materials in focused settings using simple tools.

Unit title: *Matter & Energy*

The *Matter and Energy* Unit consists of four sequential investigations to introduce the multiple forms that matter and energy can take and to give students experience with the transfer of energy from one form to another. Light absorption and reflection is the focus of an entire investigation. Students also conduct and observe chemical reactions and are introduced to atoms and elements.

Unit Title: *Structures of Life*

The *Structures of Life* Unit consists of four sequential investigations dealing with observable characteristics of organisms. Students observe, compare, categorize, and care for a selection of organisms, and in so doing they learn to identify properties of plants and animals and to sort and group organisms on the basis of observable properties. Students investigate structures of the organisms and learn how some of the structures function in growth and survival.

**Grade 4**

Unit Title: *Water*

The *Water* Unit consists of four investigations in which students explore properties of water, changes in water, interactions between water and other earth materials, and how humans use water. Water is the most important substance on Earth. Water dominates the surface of our planet, changes the face of the land, and defines life. These powerful, pervasive ideas are introduced here.

Unit Title: *Magnetism & Electricity*

The *Magnetism and Electricity* Unit consists of five sequential investigations, each designed to introduce or reinforce concepts in physical science. The investigations provide opportunities for students to explore the natural and human-made worlds by observing and manipulating materials in focused settings using simple tools.

Unit Title: *Earth Materials*

The *Earth Materials* Unit consists of four sequential investigations dealing with observable characteristics of solid materials from the earth—rocks and minerals. The focus is on taking materials apart to find what they are made of and putting materials together to better understand their properties. The module introduces fundamental concepts in earth science and takes advantage of the students' intrinsic interest in the subject matter and in the physical world around them.

Unit Title: *Human Body*

The *Human Body* Module consists of four sequential investigations that engage students in thoughtful activities about the form and function of a most remarkable machine, their own body. Students observe and investigate the human skeletal and muscle systems and learn how muscles are responsible for human movement. They also develop an awareness of human bone and muscle structure and function and an appreciation for the versatility of the human body.

**Grade 5**

Unit Title: *Solar Energy*

The *Solar Energy* Unit consists of four investigations that allow students to experience solar energy firsthand and to investigate the variables that affect solar-energy transfer. Students become aware of the potential of solar energy, an inexhaustible source, as an alternative energy source to fossil fuels, a nonrenewable source. They observe differences in size and position of shadows as a result of the relative positions of Earth and the Sun. They also observe solar energy transfer and use a compass, thermometer and other tools to measure various aspects of solar energy.

Unit Title: *Mixtures & Solutions*

The *Mixtures and Solutions* Unit has four investigations that introduce students to these fundamental ideas in chemistry. Chemistry is the study of the structure of matter and the changes or transformations that take place in it. Learning about the makeup of substances gives us knowledge about how things go together and how they can be taken apart. Learning about changes in substances is important for several reasons: changes can be controlled to produce new materials; changes can be used to give off energy to run machines.

Unit Title: *Models & Designs*

The four investigations in the *Models and Designs* Unit provide experiences that develop the concept of a scientific model and engage students in design and construction. Students exchange ideas, guide designs through conceptual and physical models, and develop ideas into products.

Unit Title: *Environments*

The *Environments* Unit consists of six investigations that introduce students to these basic concepts in environmental biology. Students learn that all living things depend on the conditions in their environment. They study the relationships between organisms and their environments and build knowledge of all organisms. With this knowledge comes an awareness of limits and the idea that changes in an environment can be hard on organisms. Students learn that such knowledge is important because humans can change environments and to do so without awareness of possible consequences can lead to disasters.

**21st Century Skills – K - 5 Science Position Statement**

This component is under development by the elementary science committee members.

6-8 Science Program Overview

**Unit Descriptions by Grade Level**

In project-based inquiry learning, students will be learning the way scientist learn: exploring interesting questions and challenges, reading about what other scientists have discovered, investigating, experimenting, gathering evidence, and forming explanations. They will learn to collaborate with others to find answers and to share their learning in a variety of ways. The students investigate scientific content and learn science practices in the context of addressing *Big Challenges* and *Big Questions* related to the world around them.

***6th Grade***

**Digging In**

*The Big Question: How do scientists work together to solve problems?* Within the context of Earth science, students explore variables, reliable procedures, fair tests, case studies, models and simulations, and use evidence to construct explanations and make recommendations to answer the Big Question. Through a series of design challenges, students explore the practices of scientists, while learning about such fundamental principles as matter, atoms, molecules, volume, density, erosion and deposition, volcanoes, and rocks and minerals.

**Ever-Changing Earth**

*The Big Question: What processes within Earth cause geologic activity?* Students use a variety of methods, including software, the Internet,and two-dimensional maps to observe differences in topographyand earthquake and volcano patterns. In the process, theylearn about the structure of Earth, the theory of plate tectonics,interaction of Earth systems, and the history of Earth. Byconnecting all of the information gathered through readings,investigations, and collaboration with others, students are able tocreate an explanation for the changes happening in the region ofspecific Earth structures they are studying.

**Energy**

*The Big Question: How can you use energy to turn out the lights?* Students design a Rube Goldberg machine to turn off thelights. In the process, students learn about the following typesof energy: Kinetic, elastic potential, gravitational potential,thermal, chemical, light, sound, and electrical. They also learnabout energy indicators. Students recognize that energy hasthe ability to do work or cause a change. Students readabout conservation of energy and renewable andnonrenewable energy sources, and observe energy transferand transformations.

***7th Grade***

**Diving Into Science**

The *Big Question:**How do scientists work together to solve problems?* Within a physical science context, students explore variables,reliable procedures, fair tests, and use evidence to constructexplanations and make recommendations to answer the***Big Question***. Through a series of design challenges,students explore the practices of scientists, while learning aboutsuch fundamental physical science principles as mass, surfacearea, and forces.

**Astronomy**

*The Big Question:**How do you know when objects in the solar system will collide?*

As part of exploring the potential for the impact of objects in space, students learn about evidence of collisions in the solar system, the components of the solar system (including the Sun, Earth, Earth’s Moon, other planets and their satellites, comets, and asteroids), the motion of those components, and the existence of other galaxies. Based on this understanding, students make a determine whether a fictional asteroid will or

will not hit Earth.

**Vehicles in Motion**

*The Big Challenge:*Design and build a vehicle and its propulsion system so that it can go straight, far, and fast in a variety of conditions. Students explore principles of motion and force, including relative motion, velocity, acceleration, Newton’s laws, friction, gravity, balanced and unbalanced forces, and net force. They use these principles to improve their design of two cars — one with and one without a propulsion system.

**Good Friends and Germs**

*The* *Big Question:**How can you prevent your good friends from getting sick?* Using some of the practices and skills used by epidemiologists,students learn about unicellular organisms such as bacteria, aswell as viruses that cause disease, cell structure and theory,levels of organization of living organisms, structure, function,and interdependence of human body systems, how diseasesaffect body systems, and how to track a disease. Students usethis information to develop a set of recommendations forstaying healthy and helping others stay healthy.

***8th Grade***

**Genetics**

The *Big Question:**How can knowledge of genetics help feed the world?* To answer the *Big Question,* students respond to a *Big Challenge:*Provide advice about developing a rice plantthat is nutritious and can be grown in places that do not geta lot of rain. After being introduced to the worldwide problem offood shortage, students investigate how to develop varieties ofrice that could help to alleviate the shortage. Within this context,students learn about sexual and asexual reproduction, Mendelianinheritance, Punnett squares, meiosis and mitosis, chromosomesand DNA, how traits and the environment interact, evolution andnatural selection, variation, natural and artificial selection, andthe promises and potential threats of genetic engineering.

**Air Quality**

The *Big Question:**How can you improve the air quality in your community?* Through numerous investigations and case studies (Los Angelesand the Adirondacks), students learn about the nature andcomposition of air and other matter, states of matter, atomictheory, bonding, the Periodic Table of the Elements, and manyother fundamental chemistry topics, as well as sources andeffects of pollution. Students apply their knowledge byinvestigating the air quality in their own community andexamining the sources, effects, and potential solutions tothe pollution problems that they identify.

**Planetary Forecaster**

The *Big Question****:*** *Which regions of a newly discovered planet have surface temperatures appropriate for a human colony?* Through a series of investigations consisting of both hands-on labsand software-based activities, students explore the major factorsaffecting temperature on Earth and then use what they learn tomake predictions of temperatures and habitable areas on a fictionalplanet. Students consider how four factors — shape of the planet,tilt of the planet’s axis, land/water differences, and surfaceelevation — affect Earth’s temperatures. In the process, theyalso learn about Earth’s atmosphere and its density, conduction, convection, and radiation of heat energy, seasons; biomes on Earth, and specific heat capacity. By investigating what factors interact to cause weather, students explore weather maps, the water cycle, changes of state, wind patterns on Earth, and severe weather occurrences.

*Unit descriptions taken from the It’s About Time, Herff Jones Education*

**21st Century Skills – 6-8 Science Position Statement**

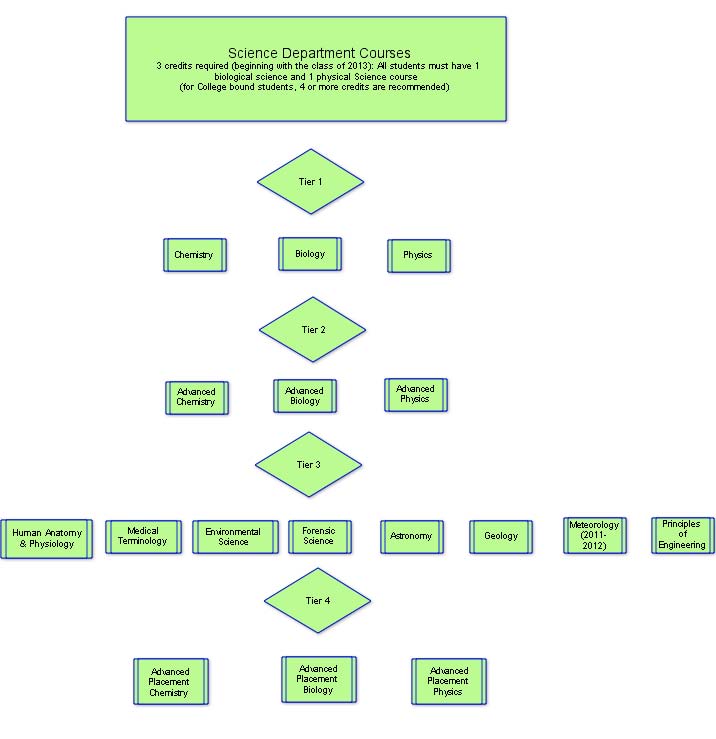
In Project Based Inquiry Science, students are continually exposed to and developing the following 21st Century Skills:

* Creativity and Innovation – Students design investigations and products based on criteria and constraints of a given challenge.
* Critical Thinking and Problem Solving – Students analyze and synthesize data and ideas as they work to answer questions.
* Communication and Collaboration – Students are able to work together while participating in scientific discussions and appropriately use claims, evidence and reasoning. Students assume shared responsibility for collaborative work.
* Life and Career Skills – Students demonstrate flexibility in thinking, being able to interact with different points of view and with different roles and responsibilities in order to meet a common goal within the specified parameters.

**9 – 12 Science Program Overview**

**SCIENCE DEPARTMENT**

The goal of the science department at Franklin High School is to develop the scientific and technological literacy of each student, and as a part of that goal is to introduce students to the idea that science is a human endeavor aimed at a better understanding of the natural world around us. The science requirement for graduation at Franklin High School is the completion of three (3) credits; one (1) of which must be a Physical Science, and one (1) of which must be a Life Science. The specific course descriptions indicate which requirement is met

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**Tier 1:**

**Chemistry**

*Grades: 9, 10, 11, 12*

*Prerequisites: None*

*Year*

*Credit: 1*

This course is an introduction to the fundamental chemistry topics: Matter, Energy, Atomic theory, the Periodic table, and Chemical Bonding and Reactions. This is a lab-based approach to the study of chemistry. *Chemistry is designed to meet the physical science graduation requirement.*

**Biology**

*Grades: 9, 10, 11, 12*

*Prerequisites: None*

*Year*

*Credit: 1*

This course is an introduction to the fundamental biology topics: nature of biology, cell biology, genetics, evolution, ecology, and the diversity of life. This course offers a lab-based, hands-on approach to the life sciences. *Biology is designed to meet the life science graduation requirement.*

**Physics**

*Grades: 9, 10, 11, 12*

*Prerequisites: None*

*Year*

*Credit: 1*

This course is an introduction to the fundamental Physics topics including motion, forces, energy, light, sound, electricity and magnetism. This is a lab-based approach to study of physics. Inquiry based activities such as rocket launching, the study of snow tubing, the energy in paper rollercoaster’s, musical instrument makeup, electromagnetic competitions as well as demonstrations and technology based laboratory activities will be used to study all topics. *Physics is designed to meet the physical science graduation requirement.*

**Tier 2:**

**Advanced Chemistry**

*Grades: 9, 10, 11, 12*

*Prerequisites: Completion or concurrent enrollment in*

*Geometry*

*Year*

*Credit: 1*

This course is a rigorous, math based, in-depth study of the fundamental topics of chemistry; Matter and Energy, Atomic theory, the Periodic Table, Chemical Bonding and Reactions. *Advanced chemistry is a lab based class, and is designed to meet the physical science graduation requirement.* This class is recommended for college-bound students and/or students intending to take AP science courses.

**Advanced Biology**

*Grades: 9, 10, 11, 12*

*Prerequisites: None*

*Year*

*Credit: 1*

This course is a rigorous and in-depth study of the fundamental biology topics: nature of biology, cell biology, genetics, evolution, ecology, and the diversity of life. This course offers a lab-based, hands-on approach to the life sciences. *Advanced Biology is designed to meet the life science graduation requirement*. This class is recommended for college-bound students and/or students intending to take AP science courses.

**Advanced Physics**

*Grades: 9, 10, 11, 12*

*Prerequisites: Completion or concurrent enrollment in*

*Geometry*

*Year*

*Credit: 1*

This course is a rigorous, math based, in depth study of the fundamental topics of physics: forces, energy, motion, fluid mechanics, electricity and magnetism, and waves and optics. *Advanced physics is a lab-based class, and* is designed to meet the physical science graduation requirement. This class is recommended for college-bound students and/or students intending to take AP science courses.

**Tier 3:**

**Human Anatomy and Physiology**

*Grades: 10, 11, 12*

*Prerequisites: Biology*

*Year*

*Credit: 1*

Human Anatomy and Physiology is a challenging biology course designed primarily for those students interested in the field of biology and, more specifically, the fields of medicine. Topics will include the anatomy and physiology of the following systems: skeletal, muscular, integumentary, digestive, respiratory, circulatory, excretory, reproductive, nervous, and endocrine. Extensive student lab work will include the gross anatomy of the cat in relationship to that of the human body. Students will gain experience in microscopy and biotechnology techniques throughout the year. In addition, student assessment will emphasize technical writing throughout the year.

**Medical Terminology/TC/MATC**

*Grades: 11, 12*

*Prerequisites: Completion of a life science course (Biology) with a C average or better*

*Semester*

*Credit: .5 (elective credit only)*

This semester course focuses on the component parts of medical terms: prefixes, suffixes, and root words. Students will practice formation, analysis, and reconstruction of terms, with an emphasis on spelling, definition, and pronunciation. Operative, diagnostic, and therapeutic and symptomatic terminology of all body systems will be analyzed in relationship to health careers. Students are required to purchase the textbook, available in school store. *This course is articulated with the statewide technical college three credit medical terminology course. Since this is a college level course, expect the rigor to be at college level.*

**(Depending on enrollment numbers, medical terminology may be offered as an off-campus course)**

**Environmental Science**

*Grades: 10, 11, 12*

*Prerequisite: Completion of one other science course.*

*Semester*

*Credit: .5*

This course is designed to teach the ecological principles and concepts required to understand the interrelationships between humans and the world in which we live. Students will evaluate and analyze environmental issues such as conservation of natural resources and the sources and impacts of pollution. Students will gain firsthand experience investigating environmental issues through laboratory fieldwork throughout the course.

**Forensic Science**

*Grades: 10, 11, 12*

*Prerequisite: Successfully completed Biology and Chemistry (Tier 1 or 2)*

*Semester*

*Credit: .5*

This course is designed for students to gain experience in the major investigative techniques currently used by forensic scientists, crime scene investigators, and other law enforcement agencies; and to develop an understanding of the scientific concepts, which serve as the basis for these techniques. Due to the potentially graphic nature of this course, students need to be aware that some of this course material may view or discuss topics related to violent crime or incidents that may reflect similar life experiences; as such, some alternate assignments may be provided.

**Astronomy**

*Grades: 10, 11, 12*

*Prerequisite: Geometry recommended, One-year science recommended, Geology recommended*

*Semester*

*Credit: .5*

Astronomy is one of the oldest sciences. It encompasses all objects and phenomena beyond the atmosphere of the earth. Students will study the solar system and universe, including the following topics: history of astronomy, gravity and motion, planets, stars, galaxies and the structure of the universe. This course places an emphasis on how astronomers gather information about distant objects without leaving the Earth, as well as various careers within astronomy. The overall goal of this course is to expose students to the scope and precesses in the universe around us.

**Geology**

*Grades: 10, 11, 12*

*Prerequisite: Biology recommended*

*Semester*

*Credit: .5*

Using rocks, minerals and maps as a foundation, students will learn about the geologic history of the earth and its implications for the future. The class will focus on the geology of the United States, and the dynamic geologic events that have shaped our continent (eg. Plate tectonics, volcanoes, earthquakes). Throughout the course, various careers in geology will also be investigated.

**Tier 4:**

**Advanced Placement (AP) Chemistry**

*Grades: 11, 12*

*Prerequisites: Completion of Chemistry with a B or better AND completion or concurrent enrollment in Advanced Algebra. Students will be issued an AP Chemistry textbook and given a multi-chapter summer assignment prior to the start of classes in fall.*

*Year*

*Credit: 1*

Advanced Placement Chemistry is a challenging, fast-paced, self-directed college level course. This is a second-year chemistry course that expands in chemistry concepts learned in the first-year chemistry course. Lab work will include computer technology, electrochemistry, kinetics, phase diagrams, buffers, oxidation-reduction, and an in-depth look at the first-year chemistry topics. Emphasis will be placed on preparation for the AP test given in May; successful performance on the test may lead to college credit at accepting institutions. *This course will provide an excellent background for those who plan to take a first-year chemistry course at college.*

**Advanced Placement (AP) Biology**

*Grades 11, 12*

*Prerequisites: Completion of both Biology and Chemistry with a B or better, in both courses. Students will be issued an AP Biology textbook and given a multi-chapter summer assignment prior to the start of classes in fall.*

*Year*

*Credit: 1*

Advanced Placement Biology is a challenging, fast-paced, college level biology course. This is a second-year biology course that expands on biology concepts learned in the first-year biology course. The course is for self-directed students who have excellent backgrounds in both their biology and chemistry classes. The course will cover the following first year major biology topics: molecular and cellular biology, bioenergetics, mendalian and molecular genetics, evolution, domain diversity, and ecological behavior. Students are required to purchase the lab report manual, available in the school store. Emphasis will be placed on preparation for the AP test given in May; successful performance on the test may lead to college credit at accepting institutions. *This course will provide an excellent background for those who plan to take a first-year biology course at college.*

**Advanced Placement (AP) Physics**

*Grades: 11, 12*

*Prerequisites: Either completion of Physics with a Grade of B or higher AND completion or concurrent enrollment in Advanced Algebra; OR if Physics has not been taken, student must be concurrently enrolled in a first semester calculus course at a university/college. Students will be issued AP Physics textbook and given a multichapter summer assignment prior to the start of class in the fall.*

*Year*

*Credit: 1*

Advanced Placement Physics is a challenging, fast-paced, self-directed college level course. This is a second-year physics course that expands on physics concepts learned in the first-year physics course. The course will cover the following major physics topics: Newtonian mechanics, fluid mechanics and thermal physics, electricity and magnetism, and waves and optics. Emphasis will be placed on preparation for the AP test given in May; successful performance on the test may lead to college credit at accepting institutions. *This course will provide an excellent background for those who plan to take a first-year physics course at college.*

**Principles of Engineering (POE)**

*Grade: 10, 11, 12*

*Prerequisite: Intro to Engineering Design; Algebra with concurrent enrollment in Geometry*

*Year*

*Credit: 1*

Level two course in the new Project Lead The Way engineering sequence. Students explore technology systems and engineering processes to find out how math, science and technology help people. This course helps students develop better problem-solving skills by immersing them in real-world engineering problems in a technology lab setting. The course uses project-based, hands-on experiences to teach students the key elements and skills of engineering and technology based careers. Students will apply their knowledge and skills of dynamics, statics, material science and product reliability to support product development and design. Projects will include 3D solid modeling, Continuous group Rube Goldberg mechanism, Mousetrap car, Battleship ballistics and Marble sorter. Units include: Types of Engineering, Communication and Documentation, Design process, Engineering systems, Statics and Strength of Materials, Materials Testing (stress), Engineering Reliability and Dynamics/Kinematics

*NOTE: Although successful completion of this course meets the Franklin High School Science requirement for graduation, it may not be recognized by colleges as a college preparatory admission credit.*

**21st Century Skills – High School Science Position Statement**

Over the course of their High School Science classes, students are continually exposed to and developing the following 21st Century Skills:

* Creativity and Innovation – Students perform investigations and work on projects that combine the basic tenets of the variety of Science subjects along with analysis and evaluation of the material they are investigating. Creative and cooperative communication skills are concurrently developed.
* Critical Thinking and Problem Solving – Reasoning/Thinking skills are honed as students interpret information that they obtain through laboratory processes and classroom instruction. They are encouraged to ask clarifying questions as well as interpret information that they process.
* Communication and Collaboration – Students are expected to be able to defend/interpret ideas and concepts that are presented across the High School curriculum. They are able to distinguish and use effective communication strategies for a variety of purposes.
* Life and Career Skills – We believe that students who successfully engage in the opportunities that FHS presents will be able to meet the demands of a technological driven society; in terms of being prepared to further develop needed job skills and to be fully involved citizens.